Building EPHT Network Content for Air Quality: Lessons from PHASE

Mark A. Werner

Wisconsin Division of Public Health

PHASE Project Objectives

- Evaluate the utility of various air quality characterization approaches for use in EPHT activities
- Gain and share experience in sharing and analyzing data on asthma and MI hospitalizations and air quality among multiple state partners
  - Critical task for EPHT network efforts

The PHASE Team

- CDC: Vickie Boothe, Leslie Fierro
- ME: Chris Paulu
- NY: Valerie Haley, Tom Talbot
- WI: Marni Bekkedal, Kristen Malecki, Mark Werner
- EPA: Fred Dimmick, Susan Stone, Tim Watkins
- APEX: Joe Alexander, Tom Bateson

What's the Problem?

- Bureaucracies collecting health and environmental data are often separate
- Temporal and spatial data gaps and differences have made analysis problematic
- Appropriate data analysis has required extensive SAS programming expertise
- No effective way to assess contribution of air pollution to disease burden in the context of asthma surveillance

How Has PHASE Helped?

- Dialogue between states and EPA has improved understanding of data strengths and limitations, and has made data exchange happen
- EPA air quality models provide daily pollutant estimates
- Development and testing of case-crossover analysis software and guide underway
- Begins process of developing joint health/pollutant surveillance measures

Key Elements of PHASE

- Health Outcome Data
- Air Quality Data
- Assigning Exposure Protocol
- Data Analysis Protocol
- Preliminary Results

Selecting Health Outcomes

- **PHASE project: Asthma & Myocardial Infarction (MI)**
  - **Relationship to air pollution well-established**
    - **PM for asthma & MI**
    - **O_3 for asthma**
  - **Reasonable numbers of hospitalizations (NY, WI) and ED visits (ME) occurring in participating states**
  - **Offered two distinct exposure-response relationships that may differ by region**
    - **Role of speciation & particle size for PM**

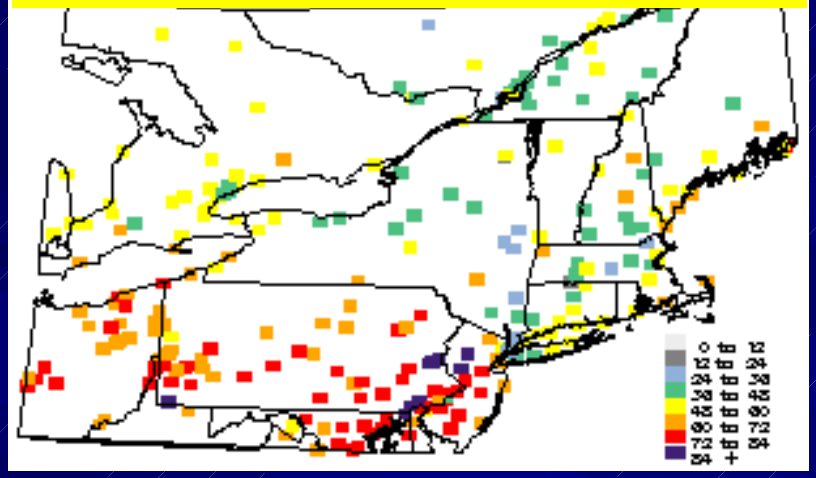
Air Quality Data

- Data and output from four AQ characterization approaches available:
  - Ambient monitoring data
  - Interpolated data
  - Community Multiscale Air Quality (CMAQ)
  - Combined CMAQ & monitoring approach (Hierarchical Bayesian)

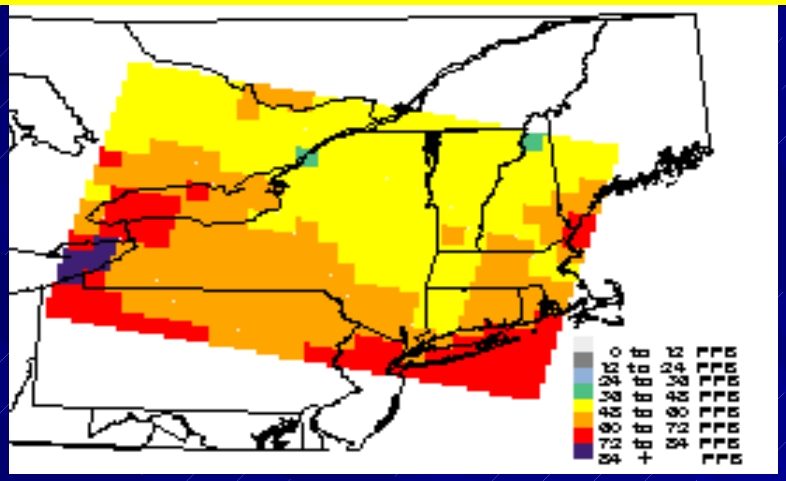
Four air characterization methods

Ozone, June 11, 2001

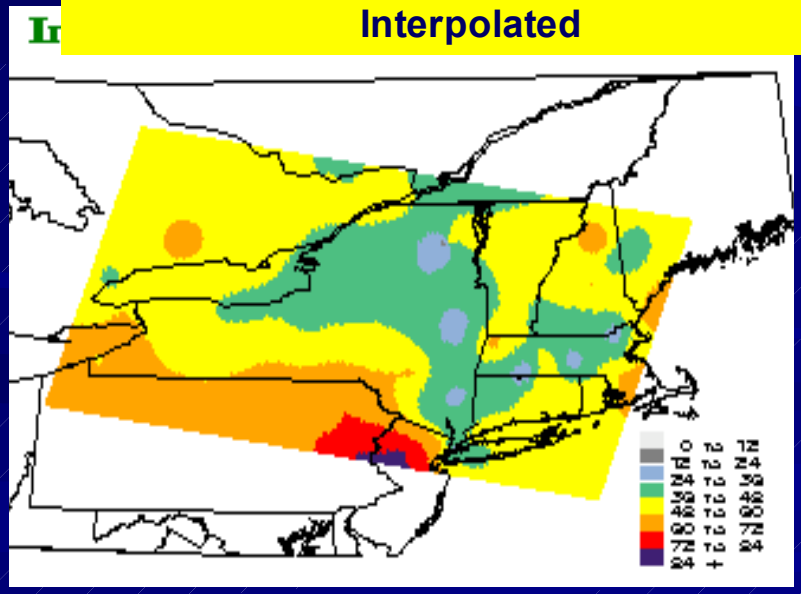
Ambient monitors



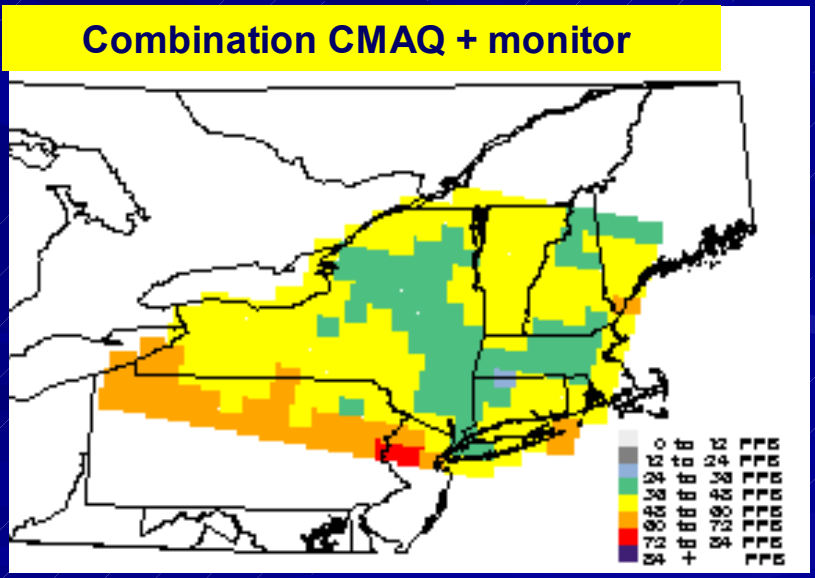
Community Multiscale Air Quality (CMAQ)



Interpolated



Combination CMAQ + monitor



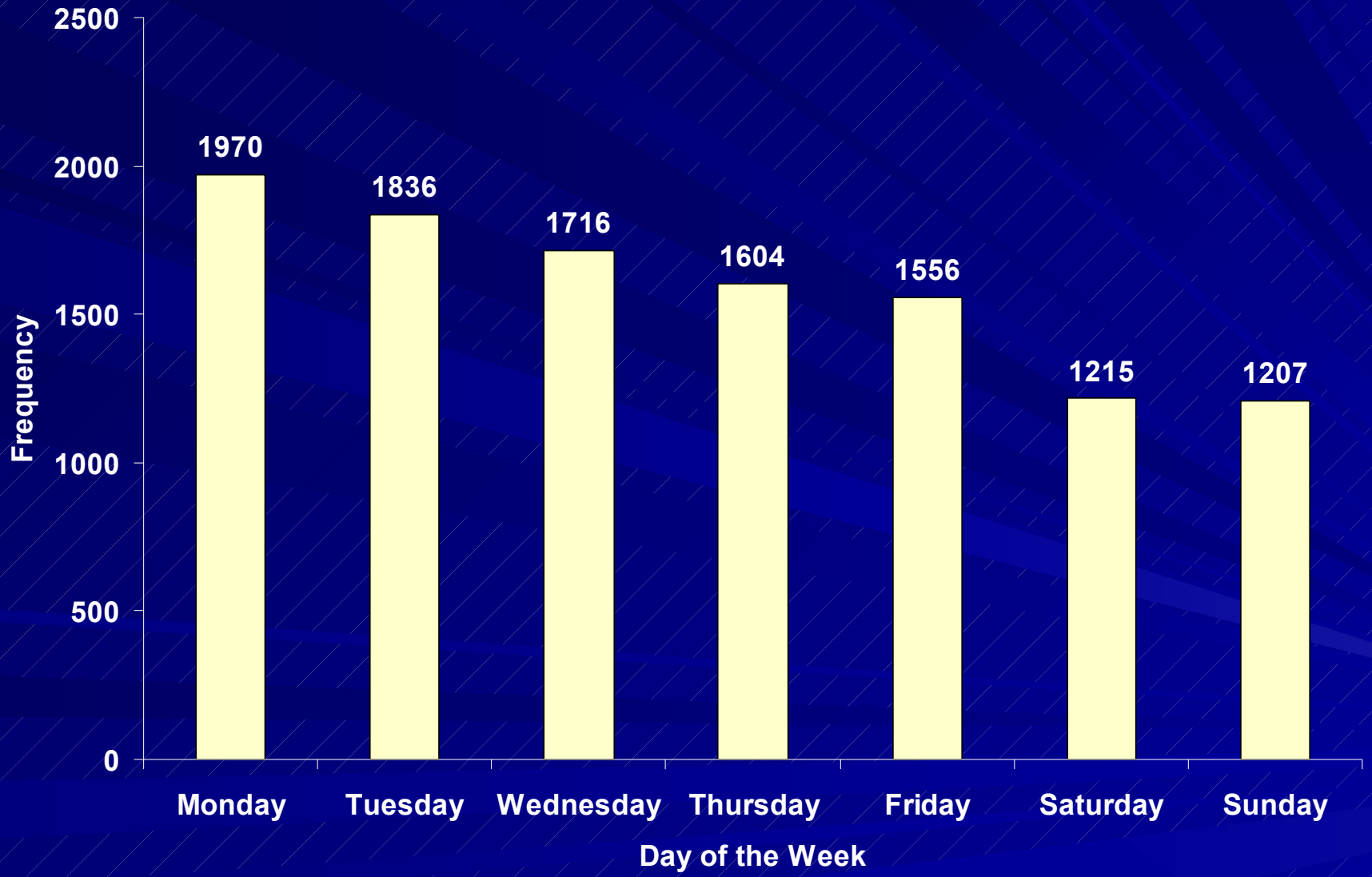
Insets provided by EPA

Case-crossover Study Design

- “Was this event triggered by something that happened just before?”
- Each case serves as his/her own control
- Example: Compare air pollution right before someone had a heart attack, to the air pollution on days with no health event.
- Capability to look at lag between exposure and health outcome included

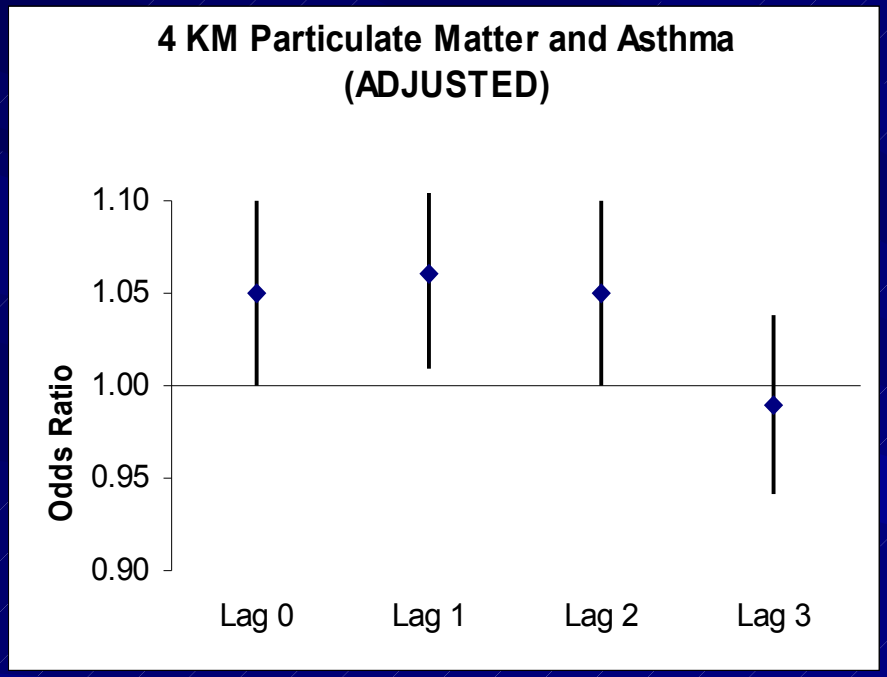
Asthma Hospitalizations in WI

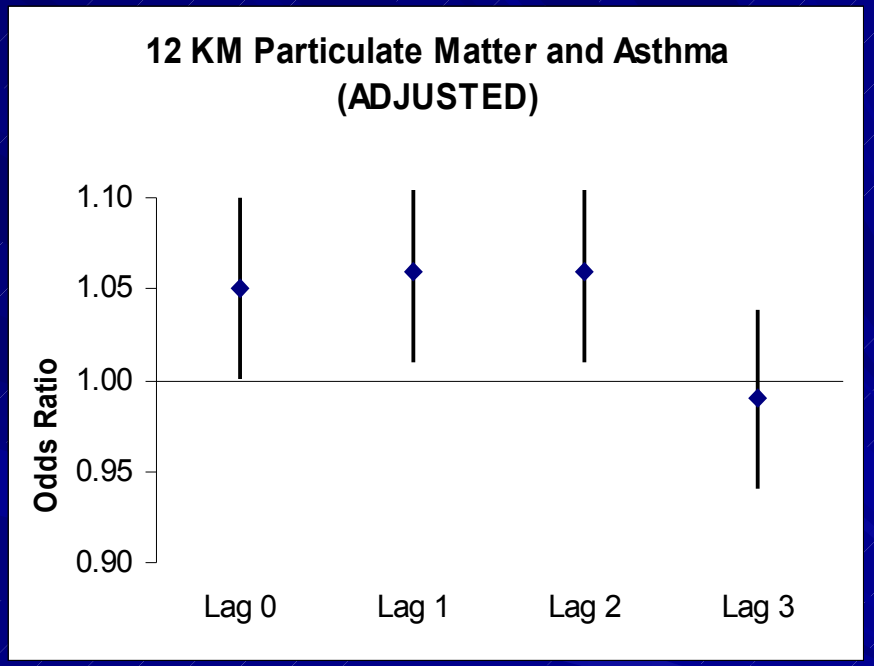
By Day of Week, 2001



Results

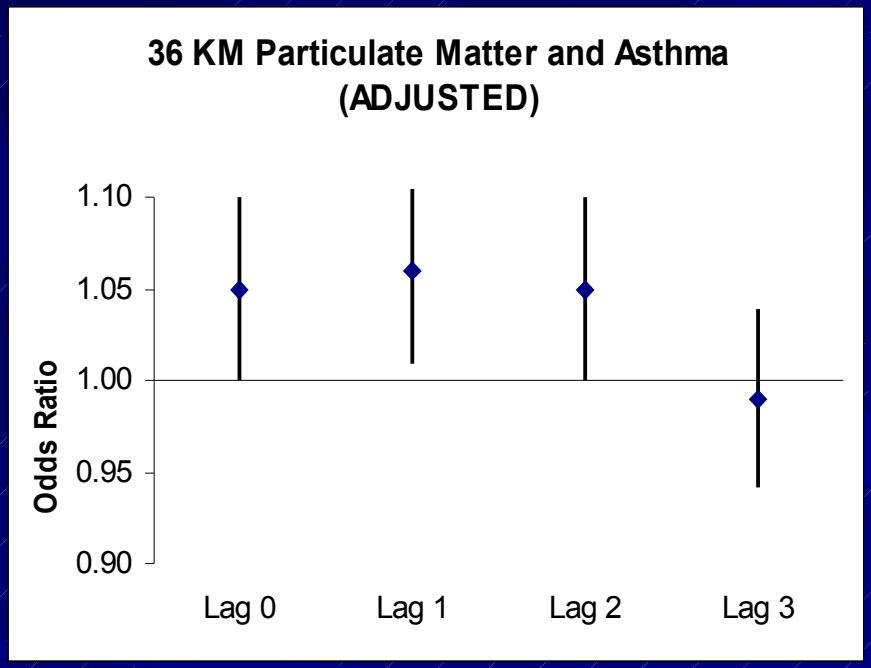
PM & Asthma
(4 km grid & 12 km grid)

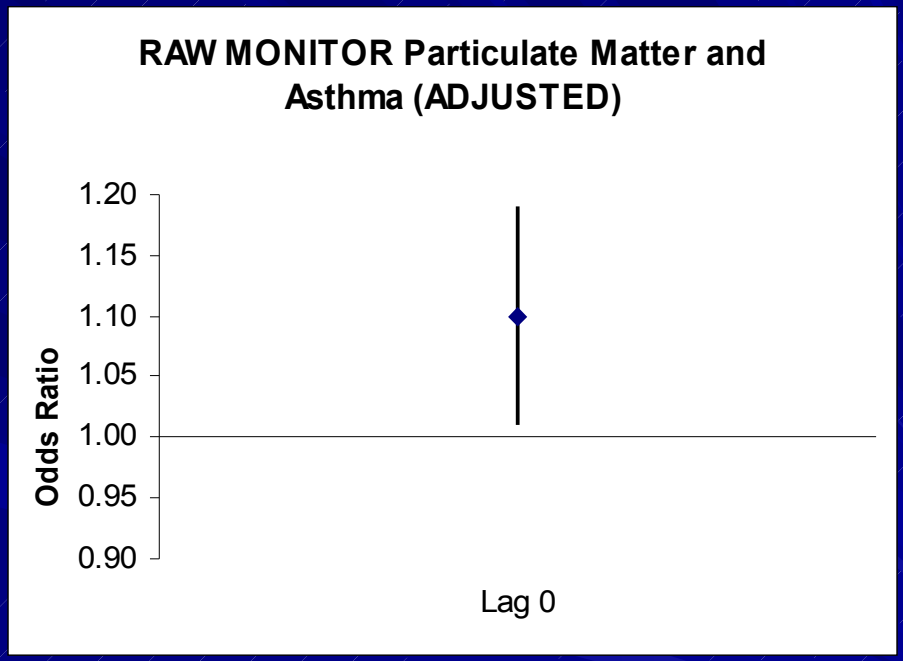




Results

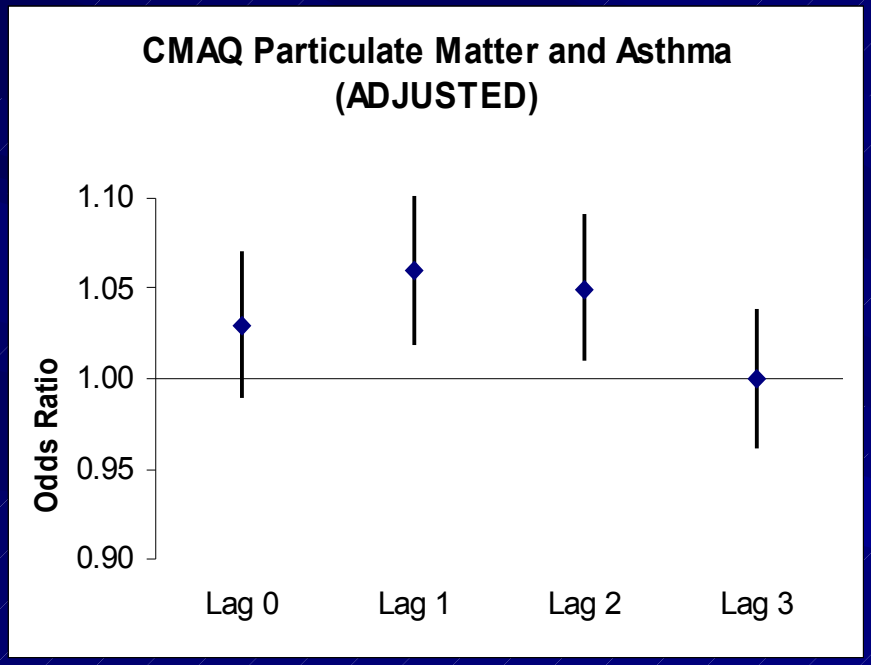
PM & Asthma
(36 km grid & raw monitor data)

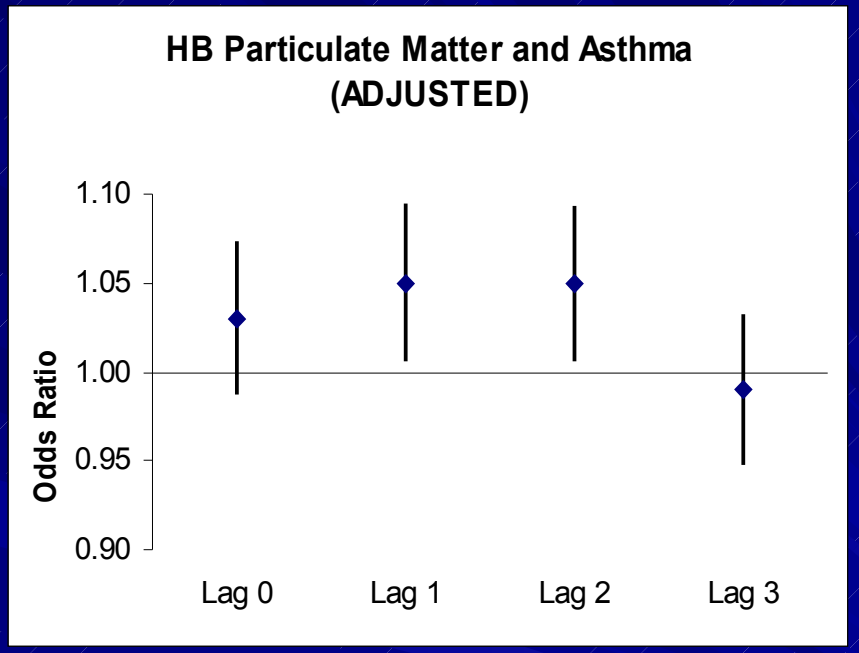




Results

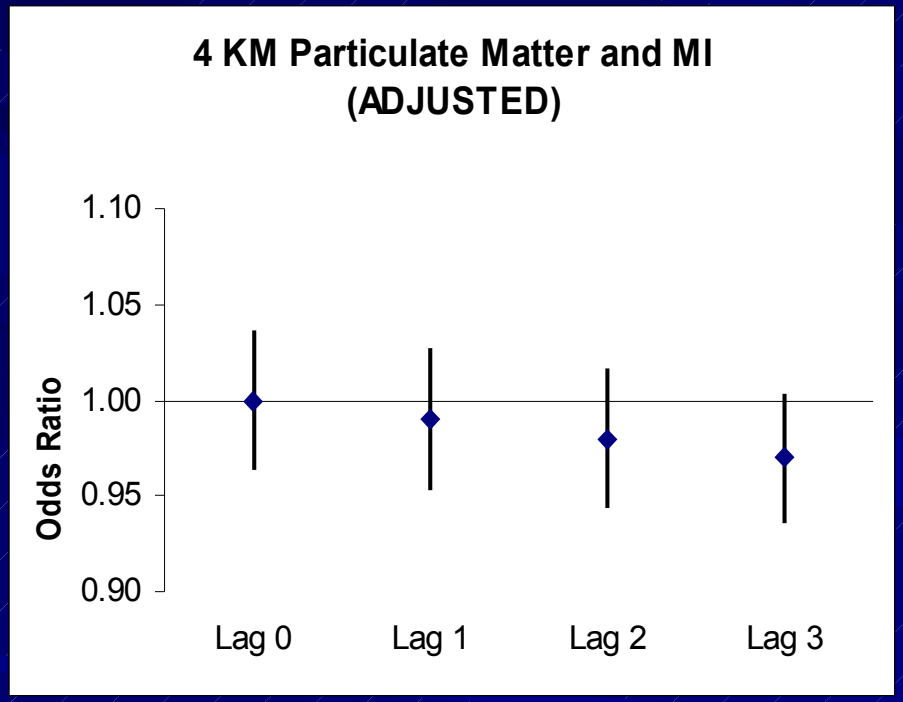
PM & Asthma (CMAQ & HB)

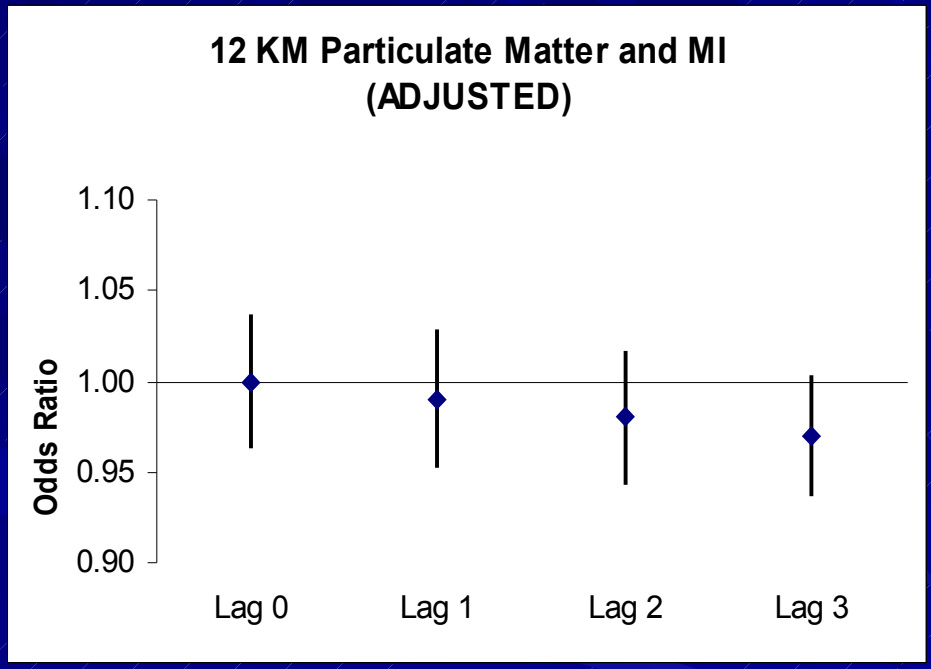




Results

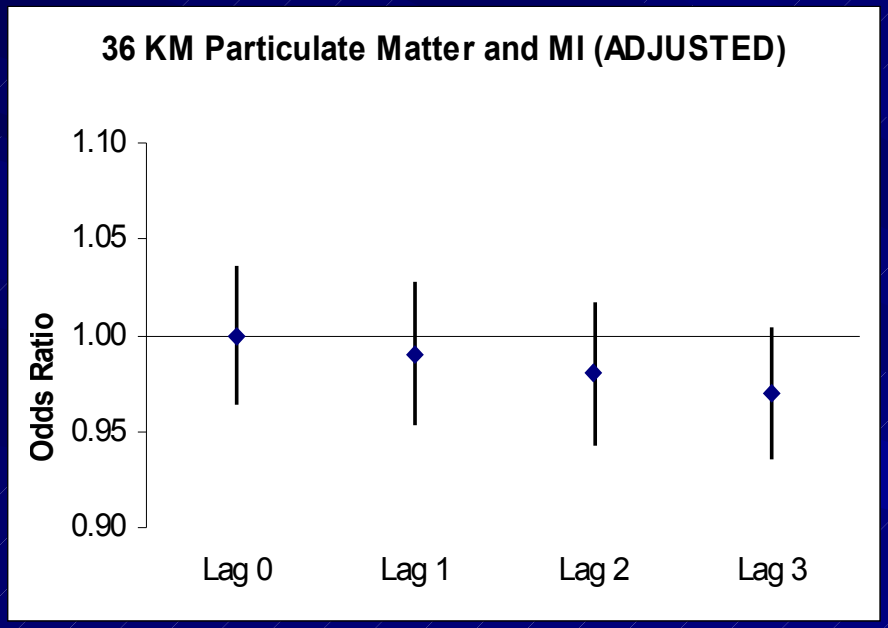
PM & Myocardial Infarction (4 km grid & 12 km grid)

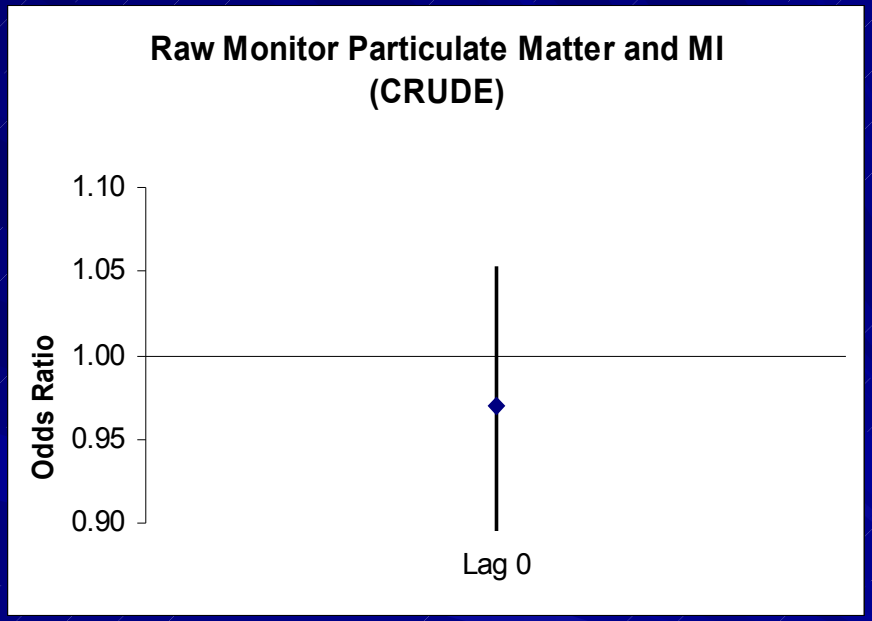




Results

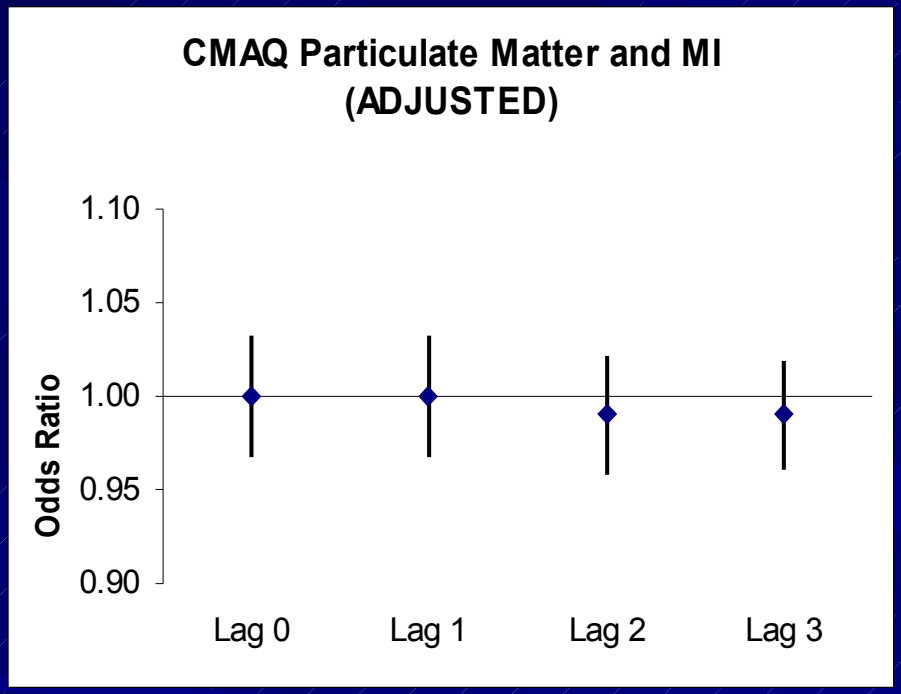
PM & Myocardial Infarction (36 km grid & raw monitor data)

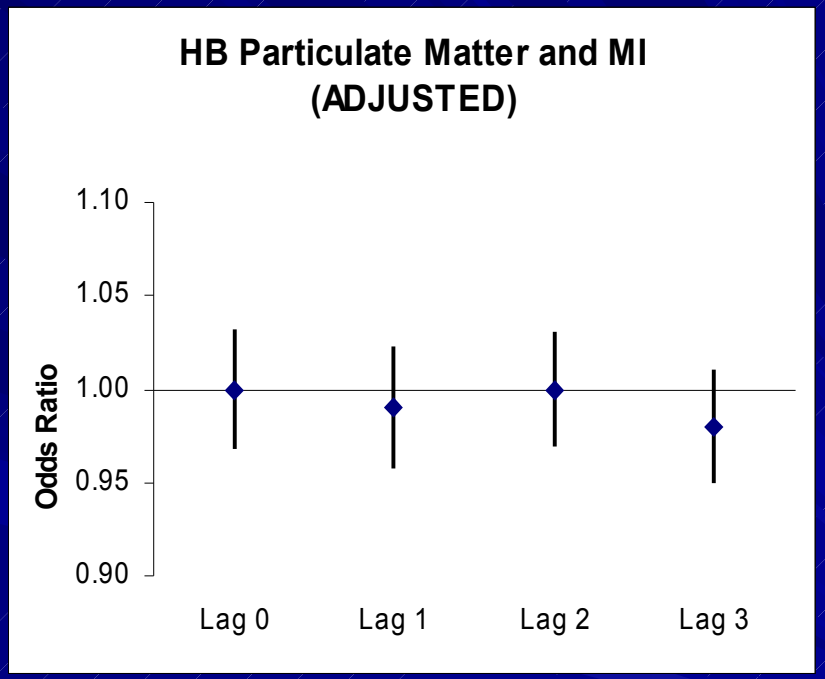




Results

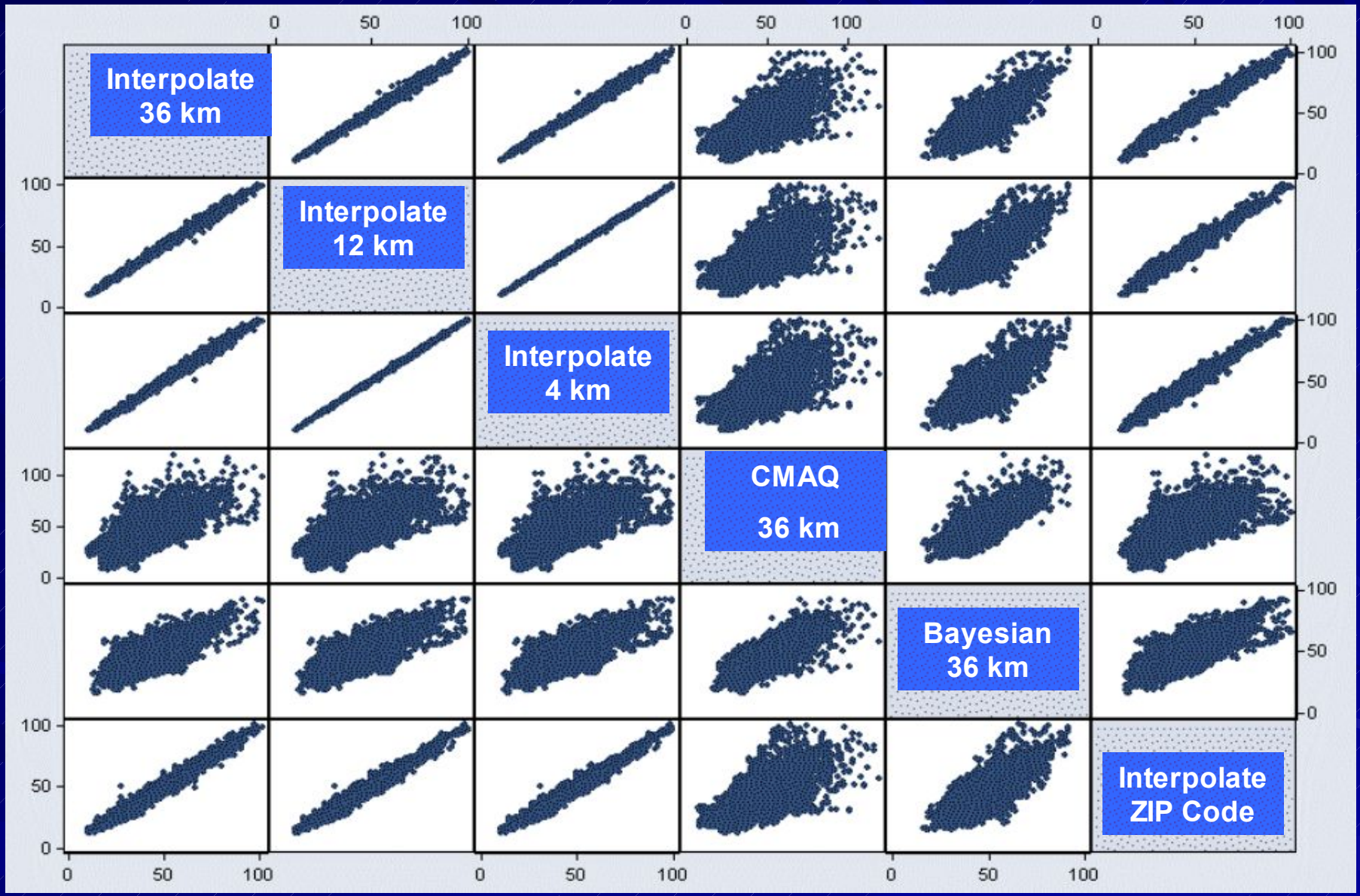
PM & Myocardial Infarction (CMAQ & HB)





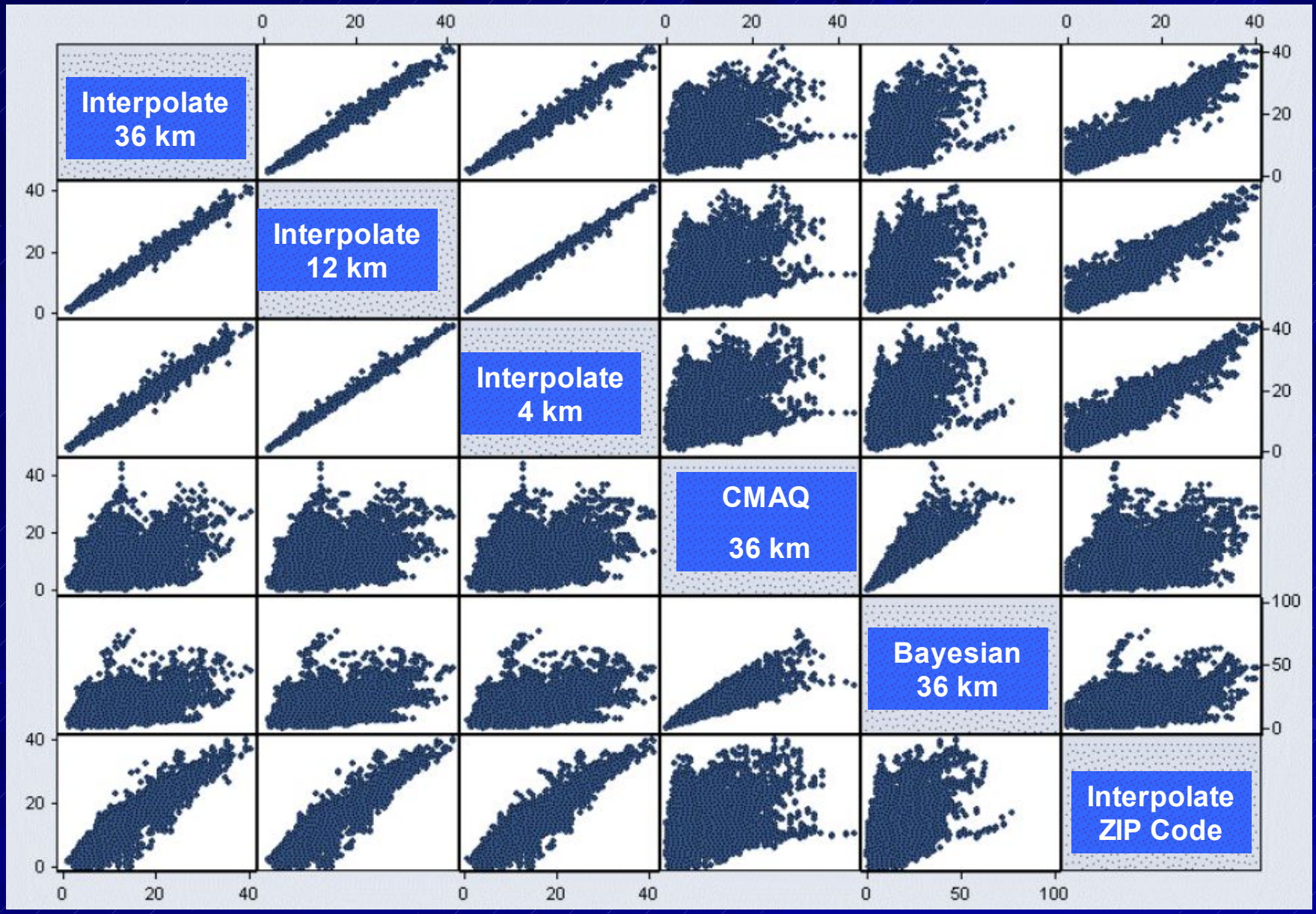
Scatterplot Matrix: Ozone

Each Data Point is a Case or Control in Maine Asthma Data



Scatterplot Matrix: $PM_{2.5}$

Each Data Point is a Case or Control in Maine Asthma Data



Supplemental Work on PHASE

- Merge ME-NY-WI health outcome data
- Include data on chemical speciation and socioeconomic status
- Write case-crossover analysis guide
- Develop software to facilitate analysis

Building the EPHT Network
Lessons from PHASE

- Understanding others' data
- Sharing and merging health outcome data
- Maximizing data and output utility
- Communicating and disseminating results

Lessons from PHASE

- Understanding Others' Data
  - Expect an ongoing dialogue
  - Include an analysis of data strengths and weaknesses
  - Prepare for additional expertise needs

Lessons from PHASE

- Sharing and Merging Health Outcome Data
  - Allow ample time for bureaucracy
  - Communicate project benefits
    - "That's why you collect these data"
  - Identify necessary and sufficient range of variables for merged database

Lessons from PHASE

- Maximizing Data and Project Utility
  - Consider project sustainability
  - Define project-specific metadata requirements
  - Work with widely-available tools

Lessons from PHASE

- Communicating & Disseminating Results
  - Respect partners' needs and constraints
  - Consider policy implications for all parties
  - Keep naturally-interested parties in the loop
    - State environmental agencies
    - State asthma & CVD programs

Current and Future Work

- Expand to subsequent years (2002-)
- Increase availability of AQ data and model output to other states
- Add emergency department data (WI)
- Develop asthma & MI hospitalization and AQ data as core measures for EPHT network
- Start improving public health interventions

Conclusions

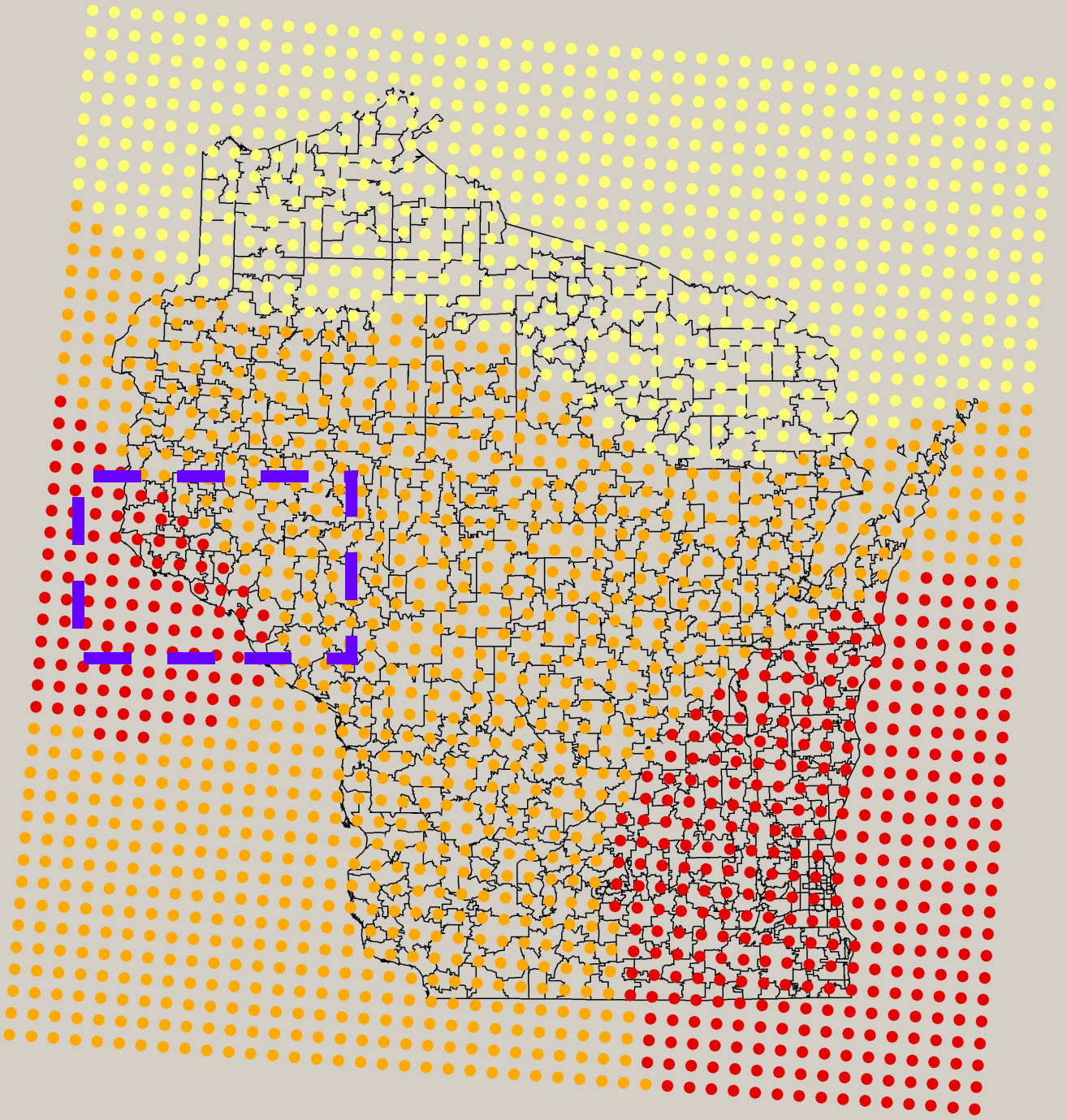
- Relationships observed in literature can be detected by PHASE approach
- Understanding and appreciating health & AQ data is a significant challenge
- Process provides useful guidance for asthma / MI / AQ EPHT network content

Exposure Assignment

- Difference in geographical specificity across states for health outcome data:
  - NY: patient address is available
  - WI & ME: only patient zip code is available
- Affects how patient exposure is assigned

Exposure Assignment Protocol

- Patient exposure assigned based on air quality value for zip code centroid corresponding to patient
  - Ambient monitor – value at nearest monitor
  - Others – 36km, 12km, 4 km grid cell or zip
- Use of population-weighted vs. geographic centroid evaluated



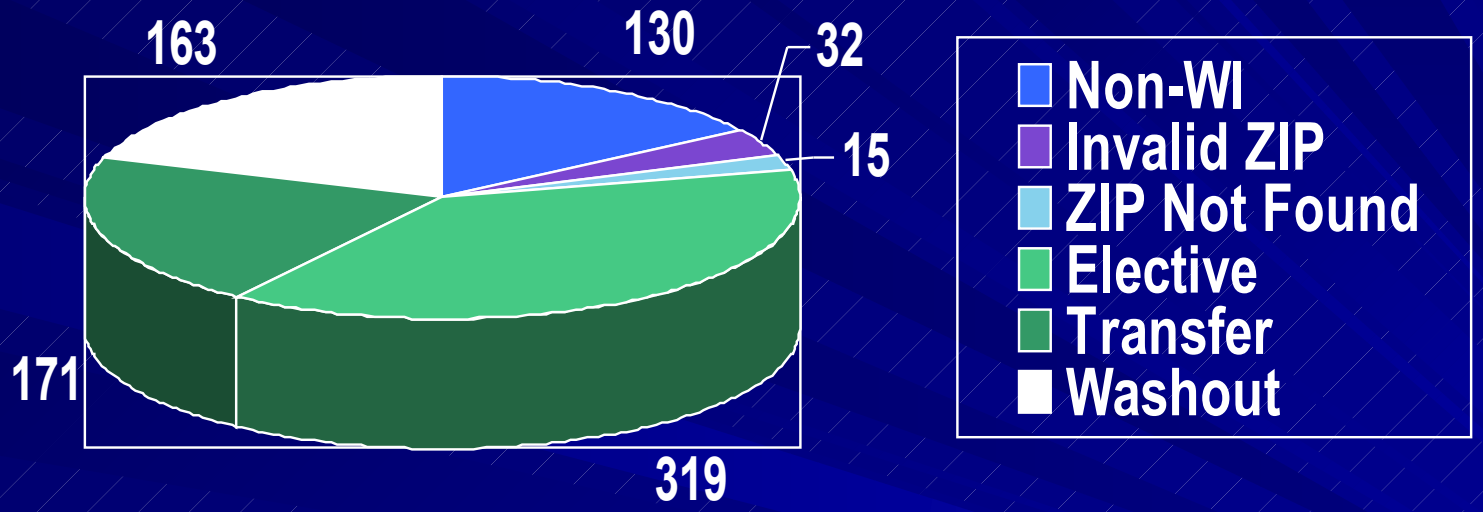
Case Definitions

Wisconsin - Exclusions

- **Residence out of Wisconsin**
- **Invalid zip code**
- **Elective admission**
- **Patient transferred from another facility**
- **Second admission within 28-day "washout period"**

Case Exclusions

Wisconsin - Asthma

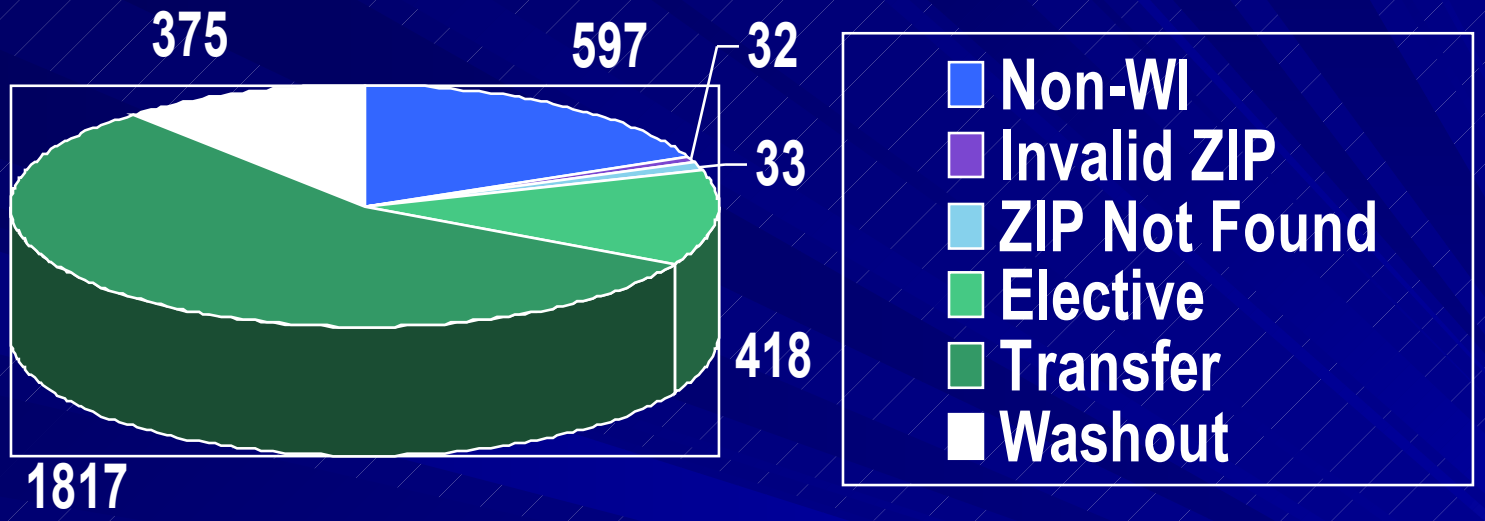


Total 2001 Admissions: 5543

Total Exclusions: 830 (15.0%)

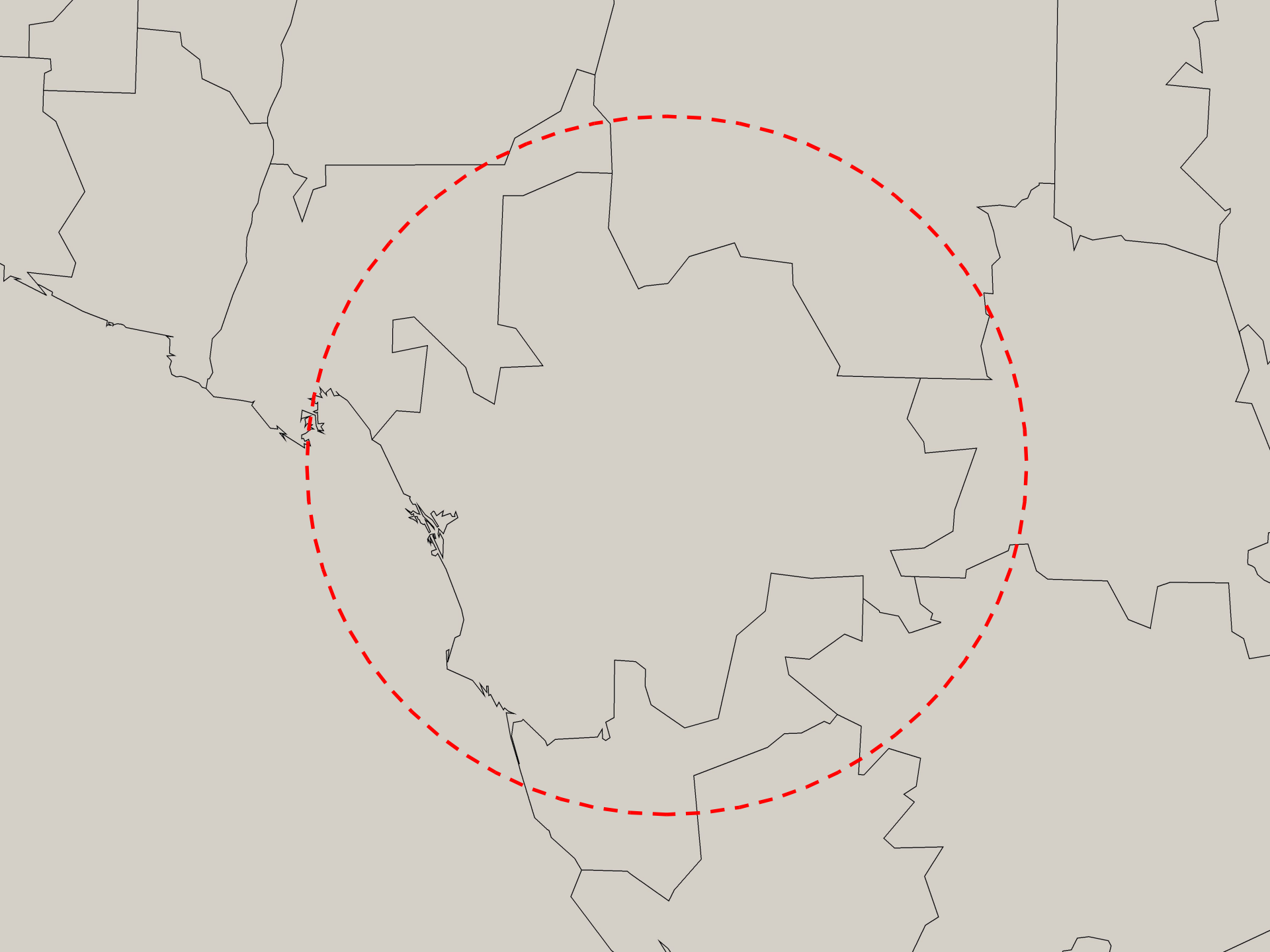
Case Exclusions

Wisconsin - MI

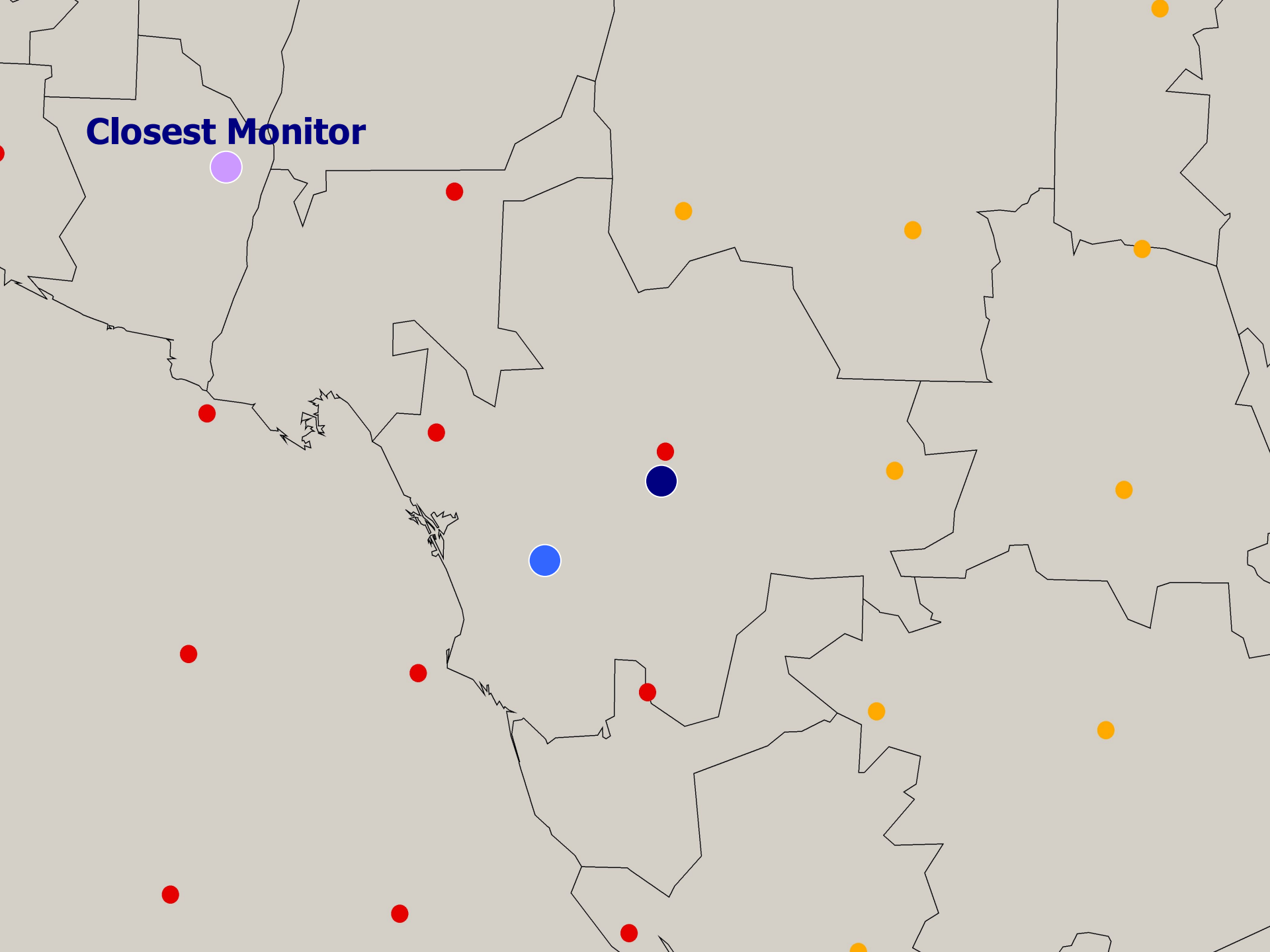


Total 2001 Admissions: 12,636

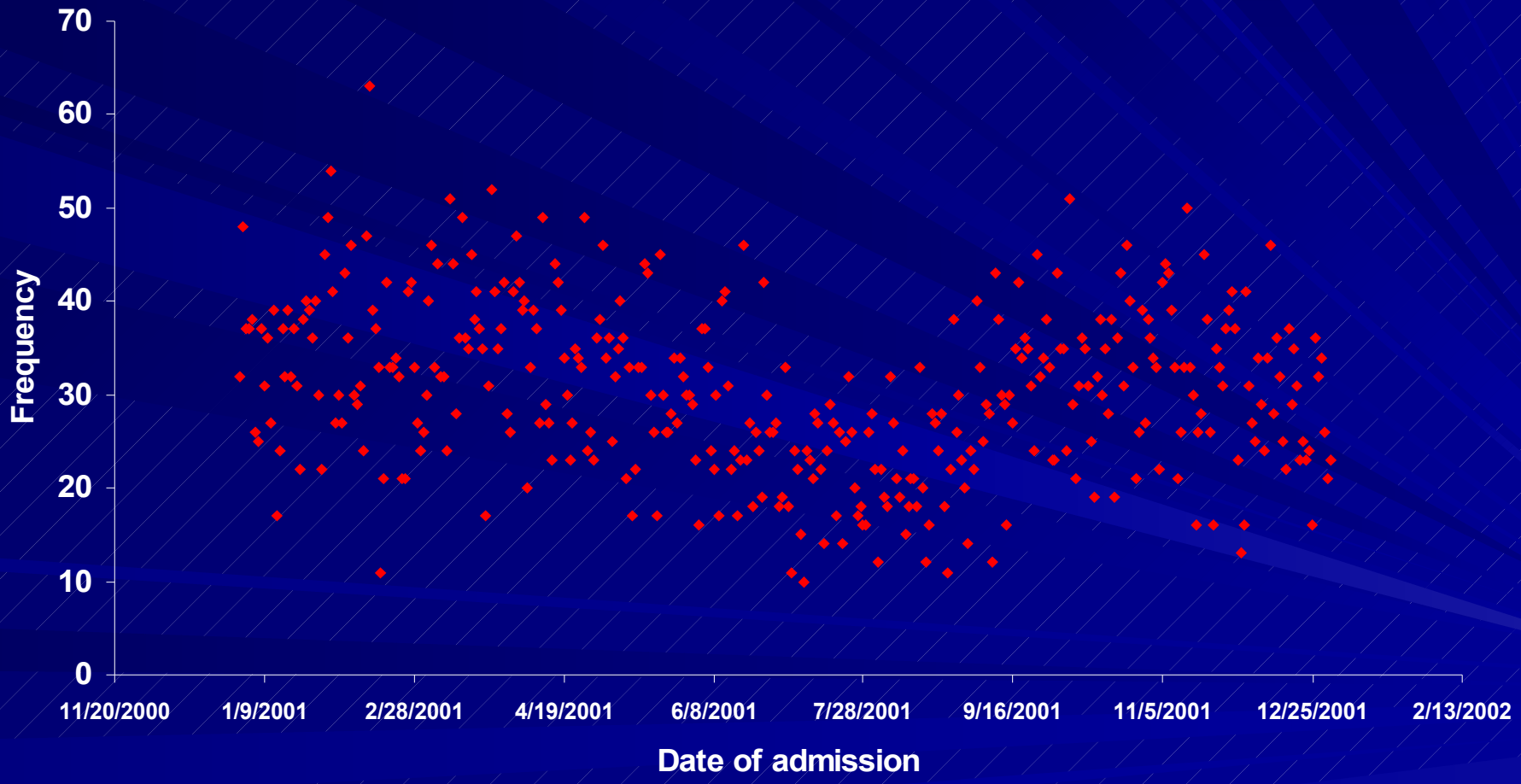
Total Exclusions: 3330 (26.3%)

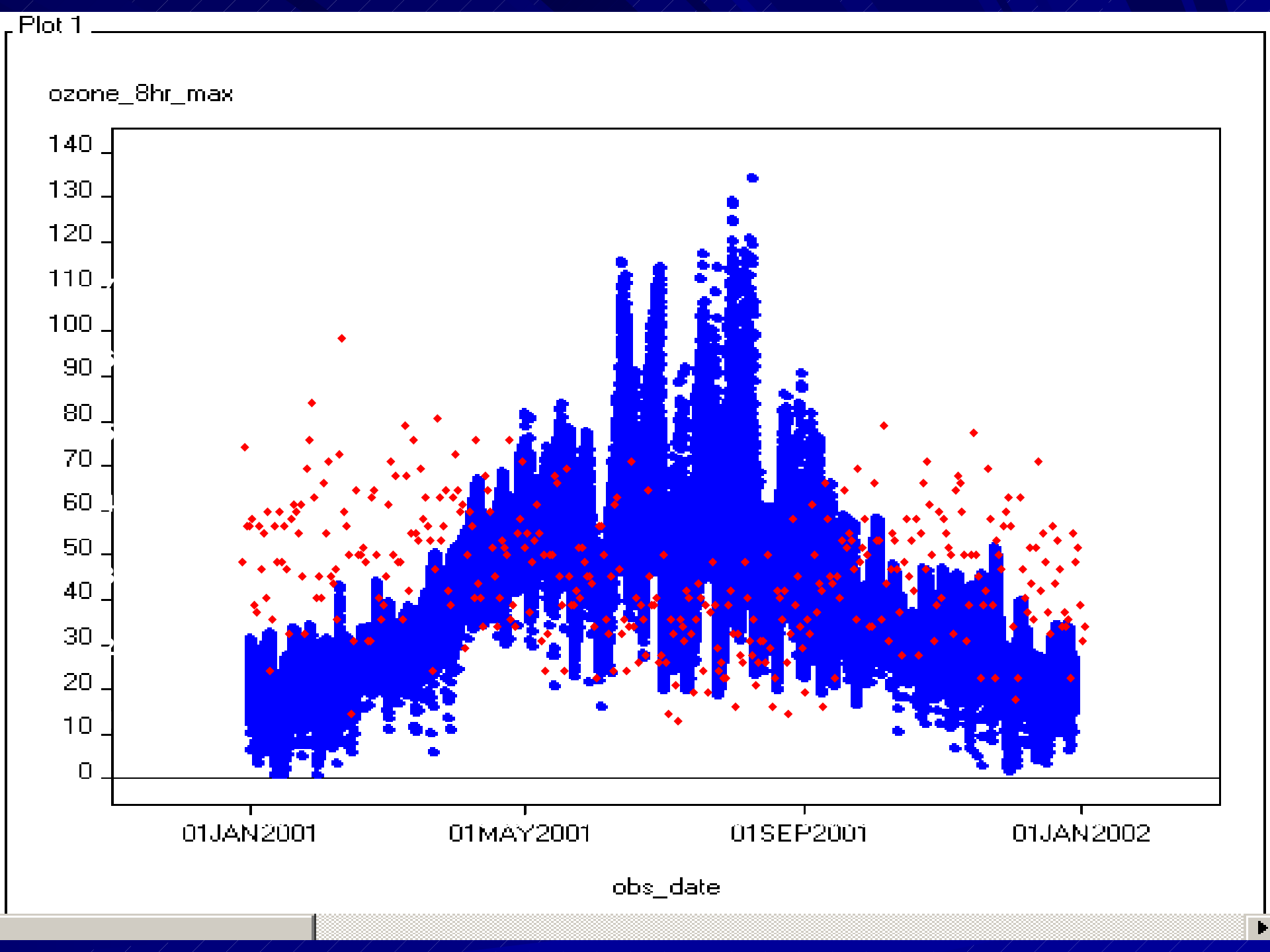



Geographic
Centroid
Population-
Weighted Centroid


Closest Monitor

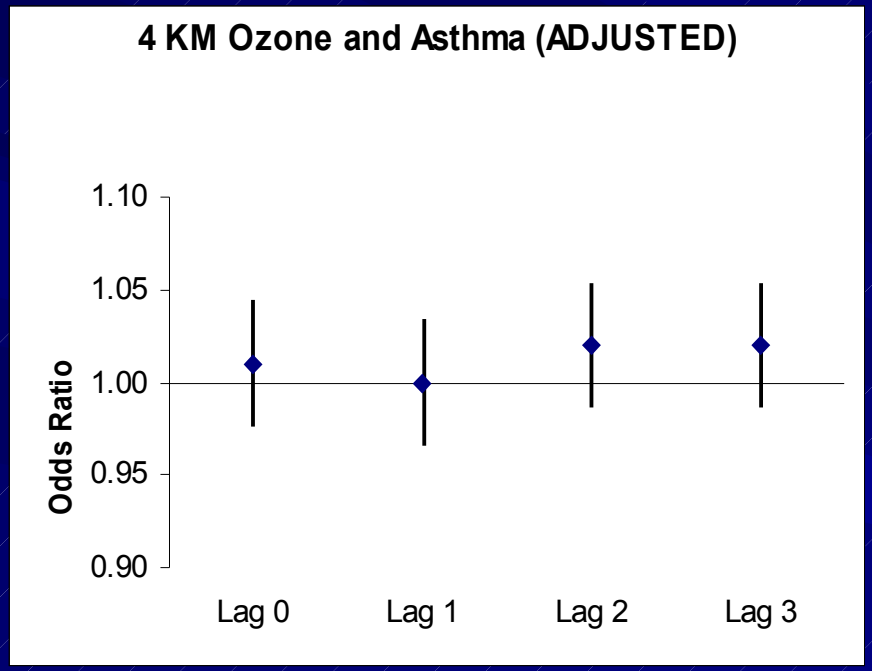
Methods
Selecting Health Outcomes

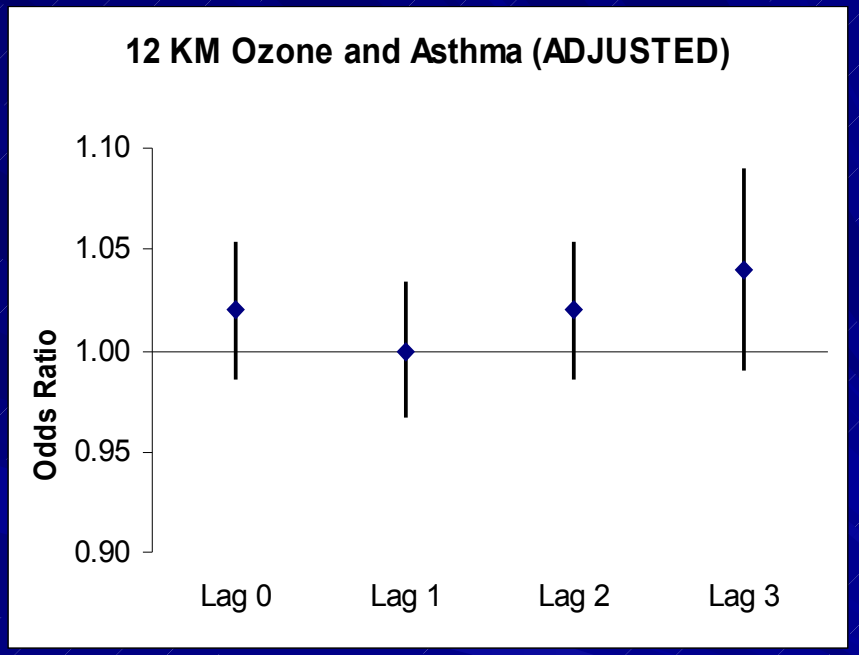



Plot 1
ozone_8hr_max
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
01JAN2001
01MAY2001
01SEP2001
01JAN2002
obs_date

Results

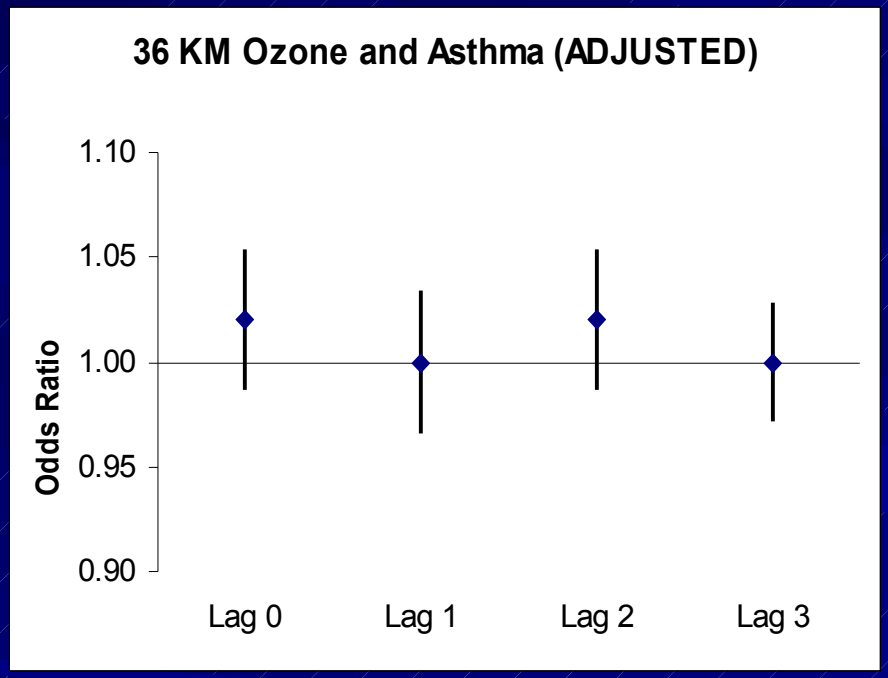
Ozone & Asthma
(4 km & 12 km grid)

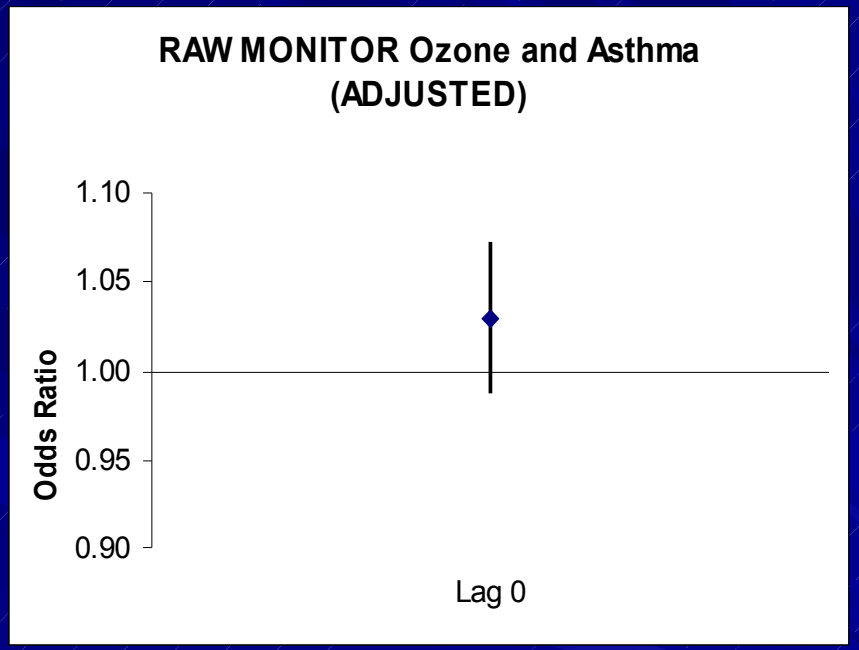




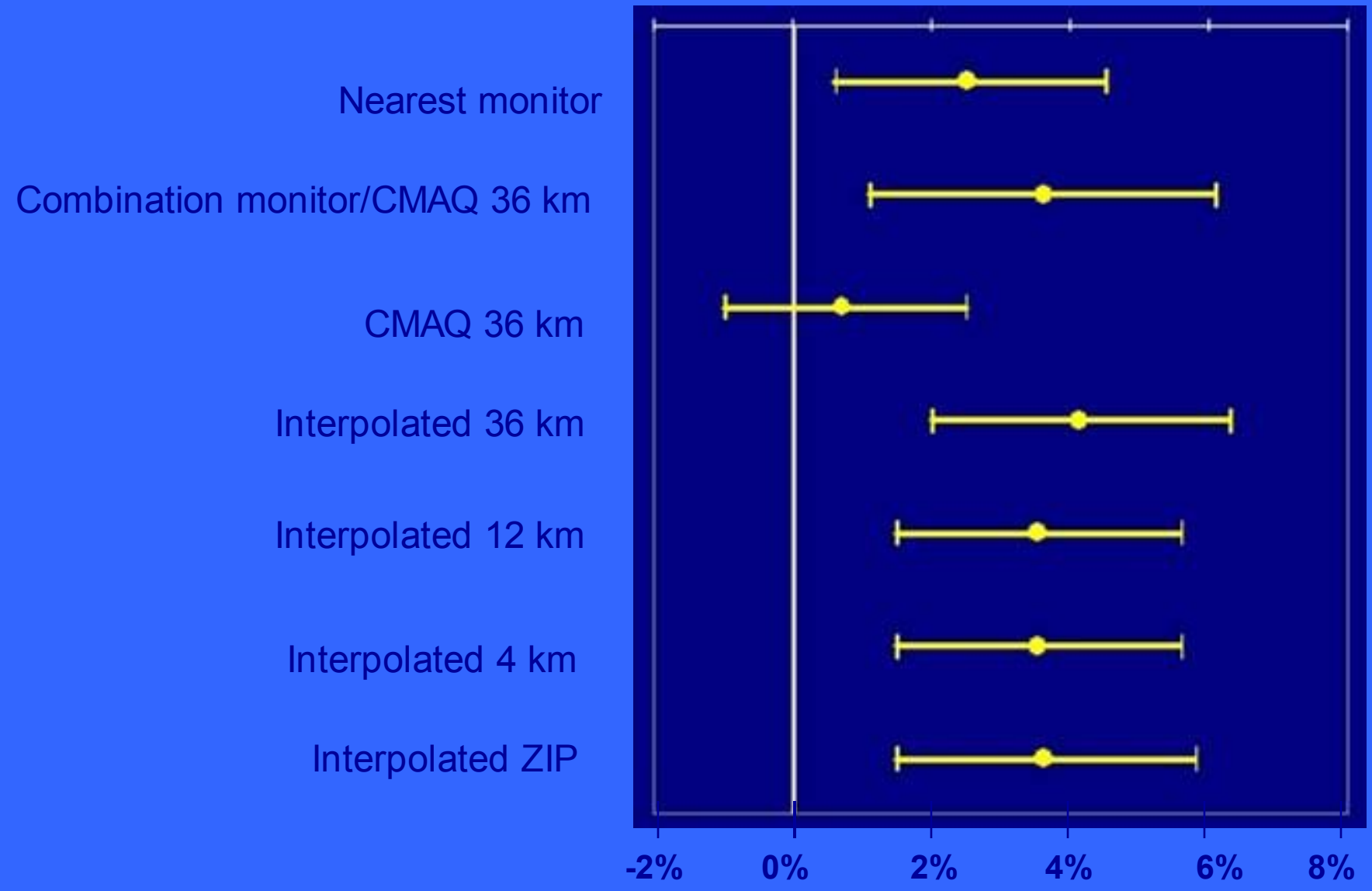
Results

Ozone & Asthma
(36 km grid & raw monitor data)

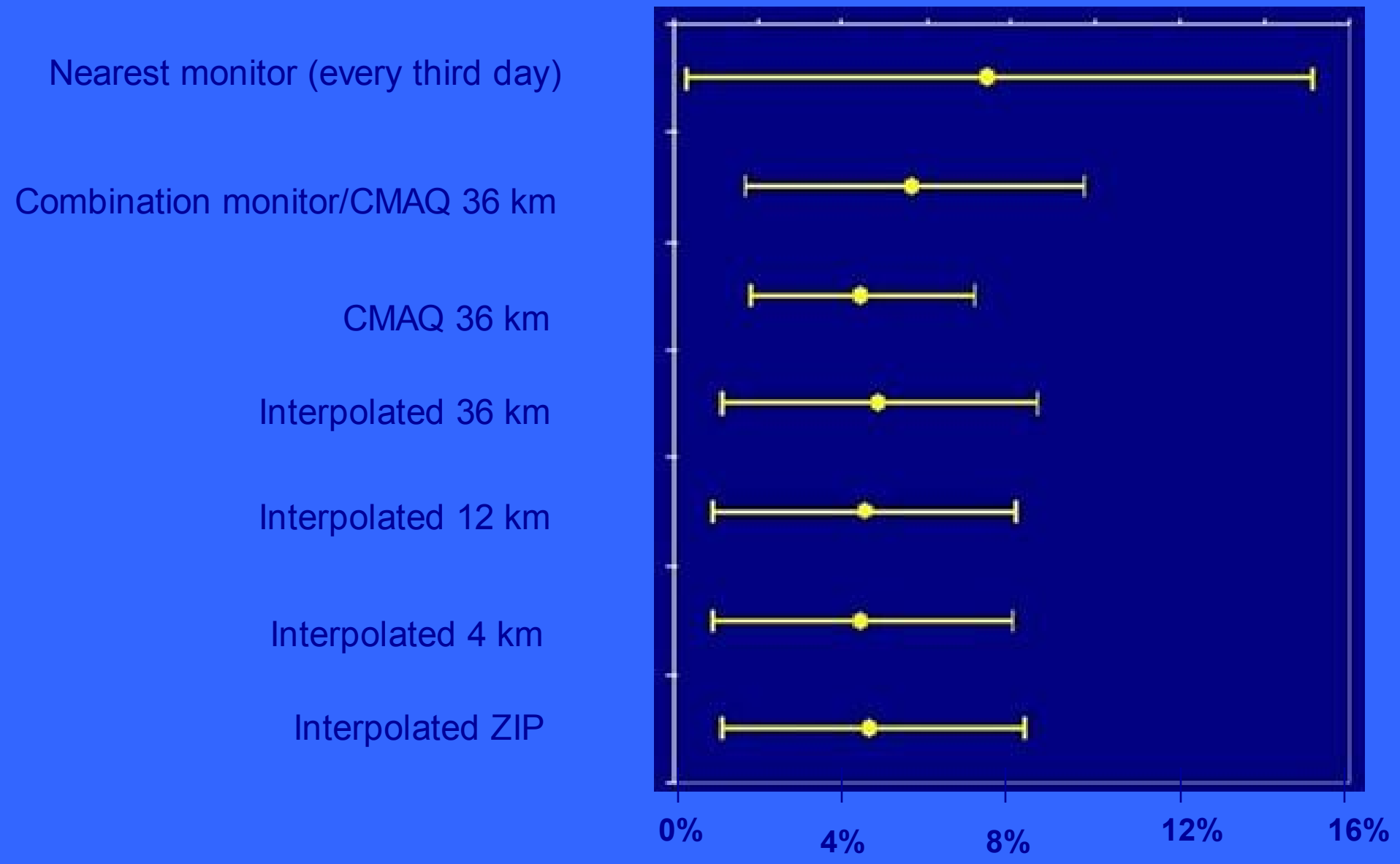




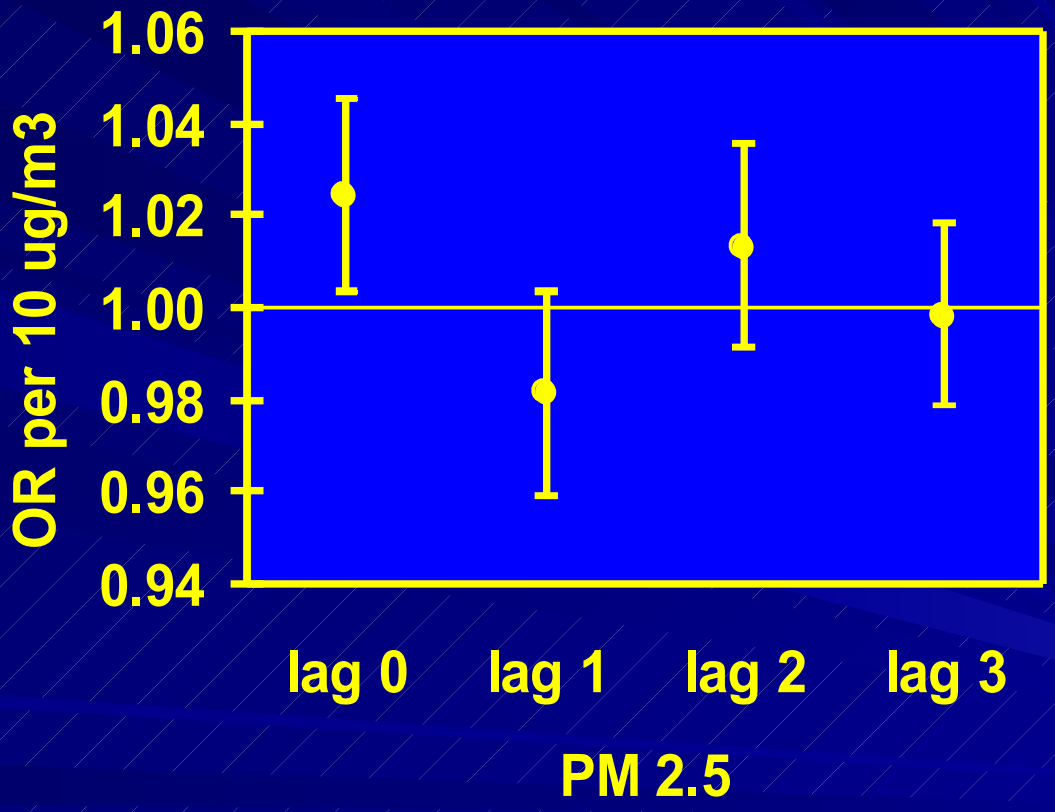
Association between asthma hospitalizations and previous day 8 hour maximum ozone concentration, New York State 2001



Association between asthma hospitalizations and $PM_{2.5}$ concentration averaged over current and previous day, New York State 2001



Association between Myocardial Infarction Hospitalizations and $PM_{2.5}$ Bayesian 36 km Estimates



New York State 2001 data: 32,265 hospitalizations

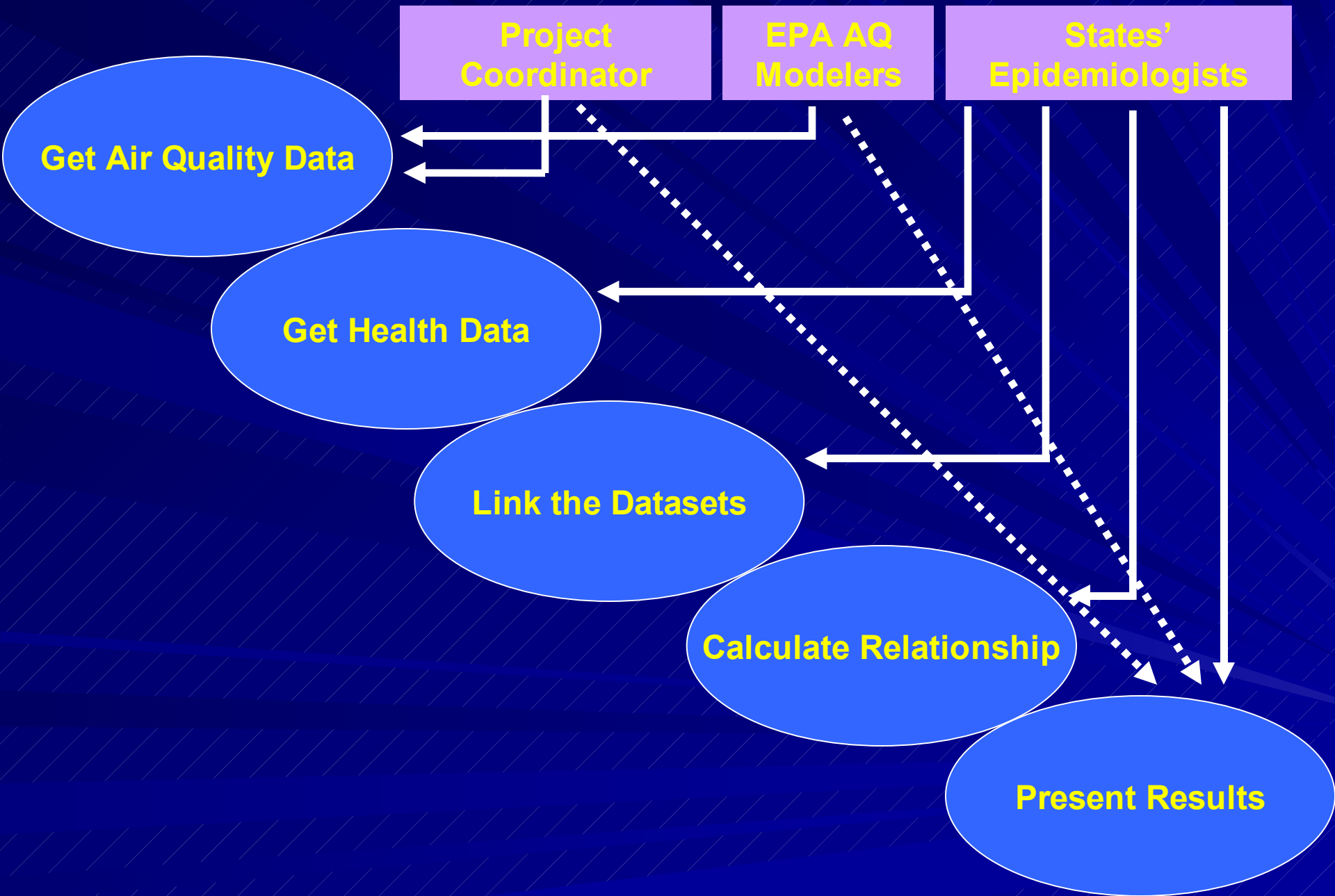
Four day distributed $PM_{2.5}$ model, controlling for temperature, humidity, and day of the week

Draft not for distribution

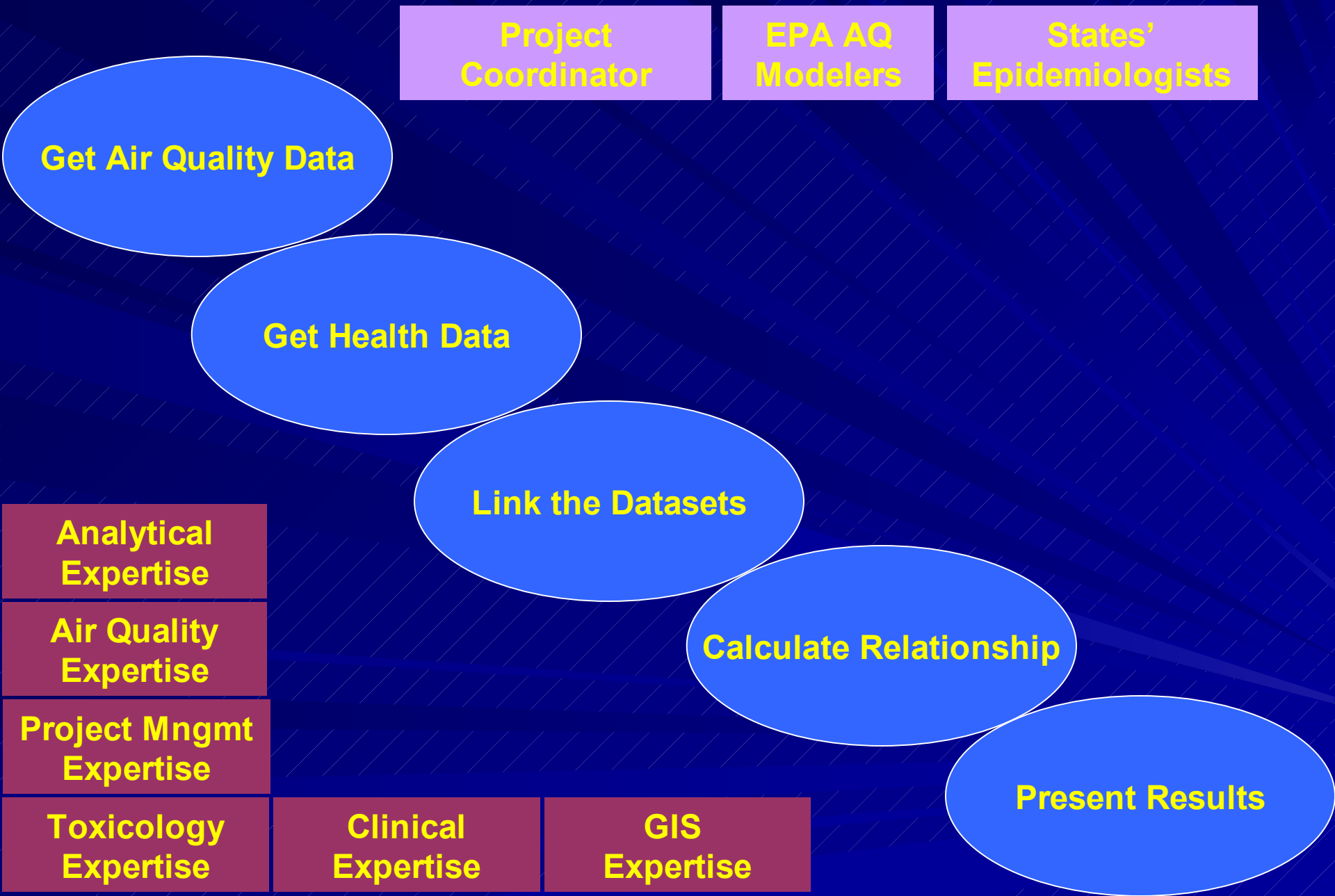
Qualitative Comparison of Air Quality Characterization Data

Data / Criteria	Ambient data	CMAQ	Statistically Interpolated	Hierarchical Bayesian
Strength of Relationship: Health & Ozone	H	L	H	H
Strength of Relationship: Health & $PM_{2.5}$	L	M	L	H

PHASE: The Vision



PHASE: The Reality



PHASE: The Reality

Project Coordinator	EPA AQ Modelers	States' Epidemiologists

Get Air Quality Data

Estimate ambient AQ with a number of different methods
Understand the strengths and limitations of the data and methods
Understand the accuracy of exposure estimates
Manage skepticism (within and outside of team)
Facilitate group communication
Negotiate the data Exchange – Format and Data Transfer
Negotiate the data Exchange – Data Sharing Agreements
Manage project goals/expectations
Manage progress

Expertise

Project Mngmt Expertise

Toxicology Expertise	Clinical Expertise	GIS Expertise

PHASE: The Reality

Project Coordinator

EPA AQ Modelers

States' Epidemiologists

Get Health Data

Identify and Define the health effects of interest
Understand the strengths and limitations of the data and methods
Facilitate group communication
Manage project goals/expectations
Manage progress

Analytic Expertis

Air Quali Expertise

Project Mngmt Expertise

Toxicology Expertise

Clinical Expertise

GIS Expertise

PHASE: The Reality

Project Coordinator

EPA AQ Modelers

States' Epidemiologists

Geographically and Temporally link AQ datasets with Health datasets
Facilitate group communications
Manage progress

Link the Datasets

Analytical Expertise

Air Quality Expertise

Project Mngmt Expertise

Toxicology Expertise

Clinical Expertise

GIS Expertise

PHASE: The Reality

Project Coordinator

EPA AQ Modelers

States' Epidemiologists

Select an analytical approach
Analyze Data, Analyze Data, Analyze Data
Evaluate different lag times and referent periods
Evaluate different variables for inclusion in models
Facilitate group communication
Manage project goals/expectations

Calculate Relationship

Analytical Expertise

Air Quality Expertise

Project Mngmt Expertise

Toxicology Expertise

Clinical Expertise

GIS Expertise

PHASE: The Reality

Project Coordinator

EPA AQ Modelers

States' Epidemiologists

Interpret the statistical results
Evaluate different AQ characterization methods
Meet the needs of all participants
Evaluate utility beyond the scope of the project
Evaluate sustainability
Facilitate group communication
Manage project goals/expectations

Present Results

Analytical Expertise

Air Quality Expertise

Project Mngmt Expertise

Toxicology Expertise

Clinical Expertise

GIS Expertise